

# Names and Addresses: IPv4

# Goal of Internet Protocol Addresses

- Stitch many different networks together
- Need network-independent, unique address

# Internet Protocol, Version 4

- An IPv4 address identifies a device on the Internet
  - ▶ Layer 3 (network) address
- 32 bits long (4 octets): a.b.c.d
  - ▶ Example: 171.64.64.64 —
  - ▶ Example: 128.30.76.82 —
  - ▶ Example: 12.22.58.30 —
- Netmask: apply this mask, if it matches, in the same network
  - ▶ Netmask of 255.255.255.0 means if the first 24 bits match —
  - ▶ Netmask of 255.255.252.0 means if the first 22 bits match —
  - ▶ Netmask of 255.128.0.0 means if the first 9 bits match —
  - ▶ Smaller netmask (fewer 1s) means larger network if  $(A \& \text{netmask} == B \& \text{netmask}) \neq 0$  on the same network

# Example: My iMac

- Turn on wireless
- Obtain, through the Dynamic Host Configuration Protocol (DHCP):
  - ▶ IPv4 address
  - ▶ IPv4 subnet mask
  - ▶ IPv4 next hop router
  - ▶ IPv4 address of Domain Name Service (DNS) server to use (maps names like www.cnn.com to an address)

# Quiz

For each source, destination, and netmask, mark whether the destination is in the same network as the source.

Source	Destination	Netmask	Same Network?
128.34.1.15	128.35.1.15	255.255.0.0	NO
10.0.1.4	10.0.1.5	255.255.255.0	YES
10.0.1.4 <sup>171.64.15.32</sup>	10.0.2.5 <sup>171.64.15.0</sup>	255.255.255.0	NO
171.64.15.33	171.64.15.5	255.255.255.224	NO
171.64.15.33	171.19.201.2	255.0.0.0	YES

# Address Structure (historical)

- Originally hierarchical: network + host
  - ▶ Network to get to correct network (administrative domain)
  - ▶ Host to get to correct device in network (within administrative domain)
- Originally 3 classes of addresses: class A, class B, class C

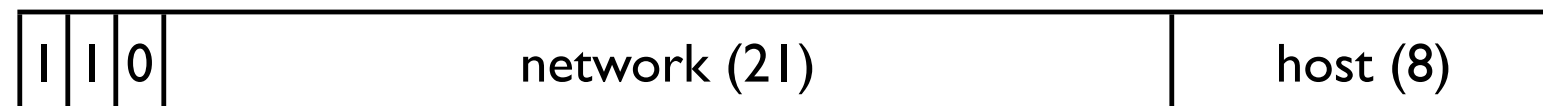
Class A



Class B



Class C



# Address Structure Today

- Still assign contiguous ranges of addresses to nearby networks
  - ▶ Class A, B, C is too coarse grained (e.g., MIT dorms!)
  - ▶ <http://news.stanford.edu/news/1999/january27/itss127.html>
- Classless Inter-Domain Routing (CIDR)
  - ▶ Address block is a pair: *address,count*
  - ▶ Counts are powers of 2, specify netmask length
  - ▶ 171.64.0.0/16 means any address in the range 171.64.0.0 to 171.64.255.255
  - ▶ A /24 describes 256 addresses, a /20 describes 4,096 addresses
- Stanford today has 5 /16 blocks -- 325,000 addresses

# IPv4 Address Assignment

- IANA: Internet Assigned Numbers Authority
  - ▶ Internet Corporation for Assignment of Names and Numbers (ICANN)'s job
- IANA gives out /8s to Regional Internet Registries (RIRs)
  - ▶ Ran out in February 2011, in special end case of giving 1 to each RIR
- RIRs responsible for geographic regions, each has own policy
  - ▶ AfriNIC: Africa
  - ▶ ARIN: U.S.A., Canada, Caribbean, Antarctica
  - ▶ APNIC: Asia, Australia, New Zealand
  - ▶ LACNIC: Latin America, Caribbean
  - ▶ RIPE NCC: Europe, Russia, Middle East, Central Asia